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MICROWAVE PATH PROPAGATION RELIABILITY PREDICTIONS

INDEPENDENT HILL - ROSSLYN

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COMSEARCH INCORPORATED

MICROWAVE PATH PROPAGATION RELIABILITY PREDICTIONS

INDEPENDENT HILL - ROSSLYN

Prepared for
OVERSEAS TELECOMMUNICATIONS, INC.
ROSSLYN, VIRGINIA

COMSEARCH, INC.
SYSTEMS ENGINEERING DIVISION
1307 GLENVILLE DRIVE
RICHARDSON, TEXAS 75081

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ALINSTARCH INCORPORATED

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I. INTRODUCTION

This report presents the results of frequency studies and path propagation reliability predictions performed on behalf of Overseas Telecommunications, Inc. for the proposed microwave system connecting customer transmit-receive earth terminal facilities in Independent Hill, Virginia with office facilities in Rosslyn, Virginia.

The microwave path study report issued January 6, outlined numerous interconnect possibilities which appeared feasible based on field verification of potential sites together with path profile path studies. This report specifically addresses one of the most direct routings that can be achieved, namely Independent Hill - Rosslyn via a single repeater utilizing the existing self-supporting tower in Arlington, Virginia, serving station WETA broadcasting facilities.

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II. SUMMARY OF RESULTS

This section of the report summarizes the results of frequency studies and path reliability studies for the proposed microwave links connecting Independent Hill, Virginia and Rosslyn, Virginia.

FREQUENCY STUDY RESULTS

Independent Hill - Arlington (WETA) - This path is 25.3 miles in length with approximate antenna heights of 300 feet at WETA and 225 feet at Independent Hill. Frequency studies indicate a very high probability for establishing either full band 6 or 11 GHz common carrier frequencies for this link. If 6 GHz is selected for operation, it will be necessary to share frequencies with the proposed transmit-receive earth station planned at Independent Hill. Transmit frequency recommendations are:

Independent Hill		Arlington (WETA)	
6 GHz	11 GHz	6 GHz	11 GHz
5945.20V	11405V	6197.24V	10755V
5974.85H	11685H	6226.89V	10955H
6004.50V	11645V	6256.54V	10995V
6034.15H	11445H	6286.19H	10715H
6063.80V	11325V	6315.84V	11155V
6093.45H	11605H	6345.49H	10875H
6123.10V	11565V	6375.14V	10915V
6152.75H	11365H	6404.79H	11115H
	11245H		11075V
	11525H		10795H
	11485V		10835V
	11285H		11035H

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Frequency analysis was performed in the 6 GHz band assuming use of Andrew Corporation UHX10-59H or UHX12-59J series antennas in combination with Microwave Associates Radios, MA85T07H, exhibiting a transmit power of 5 watts. Refer to path data sheets in Section IVa. Andrew UHX10-107H type antennas were selected for the 11 GHz studies together with Microwave Associates MA85T126 radios exhibiting a transmit power of 1.5 watts.

Arlington (WETA) - Rosslyn - This path is 3.2 miles in length with antenna center line requirements of approximately 225 feet at WETA and 145 feet at Rosslyn (five feet above roof level). Since the path is so short, initial frequency studies were performed in the 11 GHz band. Frequency results are as follows.

11 GHz Common Carrier Band - GTE Sprint 11 GHz frequencies planned and in use at the WETA tower together with 11 GHz frequency conflicts with ATT Garden City facilities prohibit the establishment of 11 GHz frequencies on the WETA-Rosslyn link.

6 GHz Common Carrier Band - Frequency studies indicate a very high probability for establishing full band (8 duplex r.f. channels) on this link considering terrestrial facilities only. There are a number of problems with transmit earth stations in the Arlington/Rosslyn area which would have to be resolved through further office studies and confirmation through RFI field measurements. This band with a 4 duplex r.f. channel requirement probably has a 50 percent chance for utilization at this time. If it becomes necessary to use this band, there will be the further requirement to submit a waiver to the Federal Communications Commission because of the short path length involved. Justification is usually made through intended use and stringent reliability requirements.

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23 GHz Common Carrier Band - Frequency studies indicate the availability of at least five (5) duplex r.f. channels from either of two frequency plans. One or two frequencies are conditional acceptable based on further analysis work to determine local blockage. Frequencies are as listed on path data sheets of Section IVa.

PATH RELIABILITY PREDICTIONS

Path reliability prediction sheets are included in Section IVb. of the report. The following summarizes pertinent data concerning each path.

Independent Hill - Arlington (WETA)

6 GHz Band Operation

Propagation outages were predicted assuming non-diversity hot standby radio equipment configurations for 10 and 12 foot parabolic antennas and MA-COM MA85T07H 5 watt radios.

	2 Way Unavailability (Seconds Per Year)	Long Haul 2 Way Obj.
10' Antennas	39.6	19.9
12' Antennas	18.9	19.9

As noted the pro-rated long haul objective can be met using 12 foot antennas. If 99.99% overall system reliability is required for the combined satellite and terrestrial links, the pro-rated reliability for propagation only in the terrestrial link could be met using 10 foot antennas.

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11 GHz Band Operation

Propagation outages were predicted assuming non-diversity hot standby radio equipment configurations for 10 and 12 foot parabolic antennas and MA-COM MA126 0.5 watt and 0.7 watt radios.

	2-Way Unavailability Multi-Path Minutes/Yr.	2-Way Unavailability Rain Minutes/Yr.	2-Way Total Unavailability Minutes/Yr.
10' Antennas			
.5 Watt Tx.	2.95	77.9	80.9
.7 Watt Tx.	2.09	73.0	75.1
12' Antennas			
.5 Watt Tx.	1.55	68.4	69.9
.7 Watt Tx.	1.09	62.7	63.8

The above assumes worst case outages due to rain for horizontal polarizations. If vertical polarizations can be utilized the total 2-way unavailability for .5 watt operation becomes 56.8 and 45.8 minutes per year for 10' and 12' antennas respectively. For 0.7 watt transmitter operation, the total unavailability becomes 50.3 and 40.7 minutes per year respectively for 10 and 12 foot antenna application.

As can be seen, the rain outage totally controls the overall path propagation performance. This outage is due to heavy rainfall rates associated with thundercells which average 3 to 5 kilometers in circumference. Since the proposed path is in a northeasterly direction and the majority of storms move west to east, the duration of each outage will last on

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the order of 5 to 10 minutes. There will be occasions, however, when a storm cell may travel the path in the direction of transmission in which case, the outage could exceed 15 minutes or more. For planning purposes, the majority of thunderstorms experienced in the greater Washington, D.C. area occur during the summer months between the hours of 4 PM and 12 PM.

Arlington (WETA) - Rosslyn

23 GHz Band Operation

The predicted propagation outage for the path is controlled by rain and is 18.4 minutes for horizontal polarization and 10.7 minutes for vertical polarization.

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III. CONCLUSIONS

- The WETA tower in Arlington, Virginia, if available for use, can serve as an intermediate repeater point to provide microwave interconnect between Independent Hill, VA and Rosslyn, VA.

- Full band 6 GHz or 11 GHz common carrier frequencies can be assigned on the Independent Hill-Arlington (WETA) microwave link. If 6 GHz is selected, sharing must be made with proposed Independent Hill earth station.

- Five duplex 23 Ghz band frequencies are available for assignment on the Arlington (WETA) - Rosslyn link. 11 GHz is not available and 6 GHz is conditionally acceptable pending resolution of a number of interference cases from 6 GHz operating earth stations in the Arlington/Rosslyn area.

- Total cumulative outage due to propagation for a 6 GHz link to Independent Hill from WETA and 23 GHz to Rosslyn is predicted to be approximately 37 minutes for horizontally polarized 23 GHz channels or 20 minutes for vertical channels.

- Total cumulative outage due to propagation for a 11 GHz link to Independent Hill from WETA and 23 GHz to Rosslyn is predicted to be approximately 60 to 70 minutes a year randomly distributed according to thunderstorm activity. This outage could be 5 times greater during a worst case year.

- The 23 GHz radio is planned for installation at the required antenna height level on the WETA tower. This will require tower access to perform maintenance on the radio equipment.

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IV. SUPPORT DOCUMENTATION

1. Independent Hill - Arlington (WETA)
   a. Path Data Sheets
   b. Path Reliability Predictions
2. Arlington (WETA) - Rosslyn
   a. Path Data Sheets
   b. Path Reliability Predictions

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IV. SUPPORT DOCUMENTATION

1. Independent Hill - Arlington (WETA)

a. Path Data Sheets

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01/06/86

	SITE A	SITE B
SITE NAME	ARLING (WETA) VA	INDPDNT HILL VA
CALL SIGN		
LATITUDE (DDMMSS.S)	38 53 29.0	38 37 35.0
LONGITUDE (DDDMMSS.S)	77 7 55.0	77 27 23.0
GND ELEV (FT AMSL)	365	402
PRIMARY ANT (FCC CODE)	A74116	A74116
HEIGHT (FT)	300	225
LINE LOSS (DB)	2	2
TYPE	ANDREW CORPORATION UHX10-59H RF	ANDREW CORPORATION UHX10-59H RF
GAIN	43.2	43.2
RADIO TYPE (FCC CODE)	24LK01	24LK01
	MICROWAVE ASSOCIATES MA85T07H	MICROWAVE ASSOCIATES MA85T07H
POWER(DBM)	37.0	37.0
STABILITY (%)	0.005000	0.005000
LOADING	VIDEO	VIDEO
EMISSION DESIGNATOR	30000F9	30000F9
FREQUENCIES	6197.24V 6226.89H 6256.54V 5945.20V 5974.85H 6004.50V	
	6286.19H 6315.84V 6345.49H 6034.15H 6063.80V 6093.45H	
	6375.14V 6404.79H 6123.10V 6152.75H	
DISTANCE	25.32 MI	40.75 KM
BEARING (DEGREES)	223.833	43.669

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	SITE A			SITE B		
SITE NAME	ARLING (WETA) VA			INDPDNT HILL VA		
CALL SIGN						
LATITUDE (DDMMSS.S)	38 53 29.0			38 37 35.0		
LONGITUDE (DDDMMSS.S)	77 7 55.0			77 27 23.0		
GND ELEV (FT AMSL)	365			402		
PRIMARY ANT (FCC CODE)	A79515			A79515		
HEIGHT (FT)	300			225		
LINE LOSS (DB)	2			2		
TYPE	ANDREW CORPORATION U-X12-59J LF			ANDREW CORPORATION U-X12-59J LF		
GAIN	44.8			44.8		
RADIO TYPE (FCC CODE)	24LK01 MICROWAVE ASSOCIATES MA6ST07H			24LK01 MICROWAVE ASSOCIATES MA6ST07H		
POWER(DBM)	37.0			37.0		
STABILITY (%)	0.005000			0.005000		
LOADING	VIDEO			VIDEO		
EMISSION DESIGNATOR	30000F9			30000F9		
FREQUENCIES	6197.24V	6226.89H	6256.54V	5945.20V	5974.85H	6004.50V
	6286.19H	6315.84V	6345.45H	6034.15H	6063.80V	6093.45H
	6375.14V	6404.79H		6123.10V	6152.75H	
DISTANCE	25.38 MI			40.75 KM		
BEARING (DEGREES)	223.89			43.669		

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	SITE A	SITE B
SITE NAME	ARLING(WETA) VA	INDPDNT HILL VA
CALL SIGN		
LATITUDE (DDMMSS.S)	38 53 29.0	38 37 35.0
LONGITUDE (DDDMMSS.S)	77 7 55.0	77 27 23.0
GND ELEV (FT AMSL)	365	402
PRIMARY ANT (FCC CODE)	A1111G	A1111G
HEIGHT (FT)	250	275
LINE LOSS (DB)	6	7
TYPE	ANDREW CORPORATION UHX10-107H RF	ANDREW CORPORATION UHX10-107H RF
GAIN	48.4	48.4
RADIO TYPE (FCC CODE)	24S602 MICROWAVE ASSOCIATES MA6ST12G	24S602 MICROWAVE ASSOCIATES MA6ST12G
POWER(DBM)	32.0	32.0
STABILITY (%)	0.005000	0.005000
LOADING	VIDEO	VIDEO
EMISSION DESIGNATOR	25000F9	25000F9
FREQUENCIES	10755.00V 10955.00H 10595.00V	11405.00V 11685.00H 11645.00V
	10715.00H 11155.00V 10675.00H	11445.00H 11325.00V 11605.00H
	10915.00V 11115.00H 11075.00V	11565.00V 11365.00H 11245.00V
	10795.00H 10635.00V 11035.00H	11525.00H 11465.00V 11285.00H
DISTANCE	25.32 MI	42.73 KM
AZIMUTH (DEGREES)	283.853	43.669

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IV. SUPPORT DOCUMENTATION

1. Independent Hill - Arlington (WETA)

   b. Path Reliability Predictions

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CUSTOMER: OVERSEA TELCOM PATH NO: 2
SYSTEM:VIRGINIA
TYPE RADIO: MA8ST07H TYPE CARRIER: VIDEO
RF FREQUENCY (GHZ): 6.175
RECEIVER IF BANDWIDTH (MHZ): 30.
CHANNEL LOADING: 1
CALCULATED CHANNEL SLOT (KHZ): 4000 SITE A: WETA
CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR SITE B: INDEPENDENT
ENGINEER: L THELANER DATE:6 JAN 86

		SITE A:	SITE B
TOWER HEIGHT	(FT)	300	225
MAIN ANTENNA HEIGHT	(FT)	300	225
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	10	10
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	43.2	43.2
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	310	235
WAVEGUIDE LOSS (EW52) 1.2 DB/100 (FT)	(DB)	3.7	2.8
STACKING LOSS	(DB)	1.5	1.5
RADOME LOSS	(DB)	.0	.0

OTHER LOSSES	(DB)	.0
PATH LENGTH	(MI)	25.3
SPACE LOSS	(DB)	140.5
FIELD MARGIN (LOSS)	(DB)	1.0
TOTAL LOSSES	(DB)	151.0
TOTAL GAINS	(DB)	86.4
NET PATH LOSS	(DB)	64.6
TRANSMITTER OUTPUT POWER	(DBM)	35.6
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	-29.0
RECEIVER THRESHOLD	(DBM)	-79.0
THERMAL FADE MARGIN	(DB)	50.0

UNAVAILABILITY ONE-WAY		.000000627
UNAVAILABILITY ONE-WAY	SECONDS	19.8
RELIABILITY NON DIVERSITY		99.999937

PATH 2 WAY UNAVABILITY		.000001254
PATH 2 WAY UNAVABILITY	SECONDS	39.558
PATH 2-WAY RELIABILITY		99.999875

LONG HAUL OBJECTIVE 2-WAY	SECONDS	19.900

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1307 GLENVILLE DRIVE
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CUSTOMER: OVERSEA TELCOM PATH NO: 1
SYSTEM:VIRGINIA
TYPE RADIO: MA85T07H TYPE CARRIER: VIDEO
RF FREQUENCY (GHZ): 6.175
RECEIVER IF BANDWIDTH (MHZ): 30.
CHANNEL LOADING: 1
CALCULATED CHANNEL SLOT (KHZ): 4000 SITE A: WETA
CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR SITE B: INDEPENDENT
ENGINEER: L THELANER DATE:6 JAN 86

		SITE A:	SITE B
TOWER HEIGHT	(FT)	300	**225**
MAIN ANTENNA HEIGHT	(FT)	300	225
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	12	12
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	44.8	44.8
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	310	235
WAVEGUIDE LOSS (EW52) 1.2 DB/100 (FT)	(DB)	3.7	2.8
STACKING LOSS	(DB)	1.5	1.5
RADOME LOSS	(DB)	.0	.0

OTHER LOSSES	(DB)	.0
PATH LENGTH	(MI)	25.3
SPACE LOSS	(DB)	140.5
FIELD MARGIN (LOSS)	(DB)	1.0
TOTAL LOSSES	(DB)	151.0
TOTAL GAINS	(DB)	89.6
NET PATH LOSS	(DB)	61.4
TRANSMITTER OUTPUT POWER	(DBM)	35.6
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	-25.8
RECEIVER THRESHOLD	(DBM)	-79.0
THERMAL FADE MARGIN	(DB)	53.2

UNAVAILABILITY ONE-WAY		.000000300
UNAVAILABILITY ONE-WAY	SECONDS	9.5
RELIABILITY NON DIVERSITY		99.999970

PATH 2 WAY UNAVABILITY		.000000600
PATH 2 WAY UNAVABILITY	SECONDS	18.933
PATH 2-WAY RELIABILITY		99.999940

LONG HAUL OBJECTIVE 2-WAY	SECONDS	19.900

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RICHARDSON, TX 75081

CUSTOMER: OVERSEAS TELECOM PATH NO: 1
SYSTEM:VIRGINIA
TYPE RADIO: MA-12G TYPE CARRIER: VIDEO
RF FREQUENCY (GHZ): 11.200
RECEIVER IF BANDWIDTH (MHZ): 30.
CHANNEL LOADING: 1
CALCULATED CHANNEL SLOT (KHZ): 4000 SITE A: WETA
CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR SITE B: INDEPENDENT
ENGINEER: L THELANER DATE:6 JAN 86

		SITE A:	SITE B
TOWER HEIGHT	(FT)	300	225
MAIN ANTENNA HEIGHT	(FT)	300	225
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	10	10
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	48.4	48.4
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	310	235
WAVEGUIDE LOSS (WC109) 1.3 DB/100 (FT)	(DB)	4.0	3.1
STACKING LOSS	(DB)	1.5	1.5
RADOME LOSS	(DB)	.0	.0
OTHER LOSSES	(DB)	.0	
PATH LENGTH	(MI)	25.3	
SPACE LOSS	(DB)	145.6	
FIELD MARGIN (LOSS)	(DB)	1.0	
TOTAL LOSSES	(DB)	156.7	
TOTAL GAINS	(DB)	96.8	
NET PATH LOSS	(DB)	59.9	
TRANSMITTER OUTPUT POWER	(DBM)	27.0	
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	-32.9	
RECEIVER THRESHOLD	(DBM)	-79.0	
THERMAL FADE MARGIN	(DB)	46.1	
UNAVAILABILITY ONE-WAY		.000002803	
UNAVAILABILITY ONE-WAY	SECONDS	88.4	
RELIABILITY NON DIVERSITY		99.999720	
PATH 2 WAY UNAVABILITY		.000005606	
PATH 2 WAY UNAVABILITY	SECONDS	176.796	
PATH 2-WAY RELIABILITY		99.999439	
LONG HAUL OBJECTIVE 2-WAY	SECONDS	19.900	

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RAINFALL OUTAGE CALCULATION

TRANSMIT SITE	:	WETA	
RECEIVE SITE	:	INDEPENDENT	
RAIN OUTAGE METHOD	:	U.S.	
1st & 2nd RAIN RATES- MM/YR	:	173	41
1st & 2nd RAIN TIMES- MIN/YR	:	1	100
FREQUENCY BAND-GHZ	:	11.2	
PATH DISTANCE -MI	:	25.3	
FADE MARGIN IN DB	:	46.1	
WET RADOME LOSS-DB	:	2	
POLARIZATION	:	HORIZONTAL	
ANNUAL RAIN OUTAGE-MINUTES/YEAR	:	77.9	
POLARIZATION	:	VERTICAL	
ANNUAL RAIN OUTAGE-MINUTES/YEAR	:	53.8	

NOTE: CALCULATIONS OF THE RAIN OUTAGES PER YEAR ARE BASED ON EXTRAPOLATIONS OF LONG TERM RAINFALL STATISTICS. ACTUAL RAIN OUTAGES ARE TYPICALLY SEVERAL MINUTES IN DURATION BUT MAY OCCUR ONLY ONCE OVER A PERIOD OF SEVERAL YEARS

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RICHARDSON, TX 75081

CUSTOMER: OVERSEAS TELECOM PATH NO: 3
SYSTEM:VIRGINIA
TYPE RADIO: MA-12G TYPE CARRIER: VIDEO
RF FREQUENCY (GHZ): 11.200
RECEIVER IF BANDWIDTH (MHZ): 30.
CHANNEL LOADING: 1
CALCULATED CHANNEL SLOT (KHZ): 4000 SITE A: WETA
CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR SITE B: INDEPENDENT
ENGINEER: L THELANER DATE:6 JAN 86

		SITE A:	SITE B
TOWER HEIGHT	(FT)	300	225
MAIN ANTENNA HEIGHT	(FT)	300	225
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	12	12
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	49.8	49.8
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	310	235
WAVEGUIDE LOSS (WC109) 1.3 DB/100 (FT)	(DB)	4.0	3.1
STACKING LOSS	(DB)	1.5	1.5
RADOME LOSS	(DB)	.0	.0
OTHER LOSSES	(DB)	.0	
PATH LENGTH	(MI)	25.3	
SPACE LOSS	(DB)	145.6	
FIELD MARGIN (LOSS)	(DB)	1.0	
TOTAL LOSSES	(DB)	156.7	
TOTAL GAINS	(DB)	99.6	
NET PATH LOSS	(DB)	57.1	
TRANSMITTER OUTPUT POWER	(DBM)	27.0	
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	-30.1	
RECEIVER THRESHOLD	(DBM)	-79.0	
THERMAL FADE MARGIN	(DB)	48.9	
UNAVAILABILITY ONE-WAY		.000001471	
UNAVAILABILITY ONE-WAY	SECONDS	46.4	
RELIABILITY NON DIVERSITY		99.999853	
PATH 2 WAY UNAVABILITY		.000002942	
PATH 2 WAY UNAVABILITY	SECONDS	92.784	
PATH 2-WAY RELIABILITY		99.999706	
LONG HAUL OBJECTIVE 2-WAY	SECONDS	19.900	

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RAINFALL OUTAGE CALCULATION

TRANSMIT SITE	:	WETA	
RECEIVE SITE	:	INDEPENDENT	
RAIN OUTAGE METHOD	:	U.S.	
1st & 2nd RAIN RATES- MM/YR	:	173	41
1st & 2nd RAIN TIMES- MIN/YR	:	1	100
FREQUENCY BAND-GHZ	:	11.2	
PATH DISTANCE -MI	:	25.3	
FADE MARGIN IN DB	:	48.9	
WET RADOME LOSS-DB	:	2	
POLARIZATION	:	HORIZONTAL	
ANNUAL RAIN OUTAGE-MINUTES/YEAR	:	68.4	
POLARIZATION	:	VERTICAL	
ANNUAL RAIN OUTAGE-MINUTES/YEAR	:	44.2	

NOTE: CALCULATIONS OF THE RAIN OUTAGES PER YEAR ARE BASED ON EXTRAPOLATIONS OF LONG TERM RAINFALL STATISTICS. ACTUAL RAIN OUTAGES ARE TYPICALLY SEVERAL MINUTES IN DURATION BUT MAY OCCUR ONLY ONCE OVER A PERIOD OF SEVERAL YEARS

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COMSEARCH INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081

CUSTOMER: OVERSEAS TELECOM PATH NO: 2
SYSTEM:VIRGINIA
TYPE RADIO: MA-12G TYPE CARRIER: VIDEO
RF FREQUENCY (GHZ): 11.200
RECEIVER IF BANDWIDTH (MHZ): 30.
CHANNEL LOADING: 1
CALCULATED CHANNEL SLOT (KHZ): 4000 SITE A: WETA
CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR SITE B: INDEPENDENT
ENGINEER: L THELANER DATE:6 JAN 86

		SITE A:	SITE B
TOWER HEIGHT	(FT)	300	225
MAIN ANTENNA HEIGHT	(FT)	300	225
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	10	10
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	48.4	48.4
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	310	235
WAVEGUIDE LOSS (WC109) 1.3 DB/100 (FT)	(DB)	4.0	3.1
STACKING LOSS	(DB)	1.5	1.5
RADOME LOSS	(DB)	.0	.0
OTHER LOSSES	(DB)	.0	
PATH LENGTH	(MI)	25.3	
SPACE LOSS	(DB)	145.6	
FIELD MARGIN (LOSS)	(DB)	1.0	
TOTAL LOSSES	(DB)	156.7	
TOTAL GAINS	(DB)	96.8	
NET PATH LOSS	(DB)	59.9	
TRANSMITTER OUTPUT POWER	(DBM)	28.5	
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	-31.4	
RECEIVER THRESHOLD	(DBM)	-79.0	
THERMAL FADE MARGIN	(DB)	47.6	
UNAVAILABILITY ONE-WAY		.000001984	
UNAVAILABILITY ONE-WAY	SECONDS	62.6	
RELIABILITY NON DIVERSITY		99.999802	
PATH 2 WAY UNAVABILITY		.000003969	
PATH 2 WAY UNAVABILITY	SECONDS	125.162	
PATH 2-WAY RELIABILITY		99.999603	
LONG HAUL OBJECTIVE 2-WAY	SECONDS	19.900	

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RAINFALL OUTAGE CALCULATION

TRANSMIT SITE	:	WETA	
RECEIVE SITE	:	INDEPENDENT	
RAIN OUTAGE METHOD	:	U.S.	
1st & 2nd RAIN RATES- MM/YR	:	173	41
1st & 2nd RAIN TIMES- MIN/YR	:	1	100
FREQUENCY BAND-GHZ	:	11.2	
PATH DISTANCE -MI	:	25.3	
FADE MARGIN IN DB	:	47.6	
WET RADOME LOSS-DB	:	2	
POLARIZATION	:	**HORIZONTAL**	
ANNUAL RAIN OUTAGE-MINUTES/YEAR	:	**73**	
POLARIZATION	:	VERTICAL	
ANNUAL RAIN OUTAGE-MINUTES/YEAR	:	48.2	

NOTE: CALCULATIONS OF THE RAIN OUTAGES PER YEAR ARE BASED ON EXTRAPOLATIONS OF LONG TERM RAINFALL STATISTICS. ACTUAL RAIN OUTAGES ARE TYPICALLY SEVERAL MINUTES IN DURATION BUT MAY OCCUR ONLY ONCE OVER A PERIOD OF SEVERAL YEARS

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COMSEARCH INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081

CUSTOMER: OVERSEAS TELECOM PATH NO: 1
SYSTEM:VIRGINIA
TYPE RADIO: MA-12G TYPE CARRIER: VIDEO
RF FREQUENCY (GHZ): 11.200
RECEIVER IF BANDWIDTH (MHZ): 30.
CHANNEL LOADING: 1
CALCULATED CHANNEL SLOT (KHZ): 4000 SITE A: WETA
CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR SITE B: INDEPENDENT
ENGINEER: L THELANER DATE:6 JAN 86 SITE A: SITE B

TOWER HEIGHT	(FT)	300	225
MAIN ANTENNA HEIGHT	(FT)	300	225
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	12	12
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	49.8	49.8
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	310	235
WAVEGUIDE LOSS (WC109) 1.3 DB/100 (FT)	(DB)	4.0	3.1
STACKING LOSS	(DB)	1.5	1.5
RADOME LOSS	(DB)	.0	.0

OTHER LOSSES	(DB)	.0
PATH LENGTH	(MI)	25.3
SPACE LOSS	(DB)	145.6
FIELD MARGIN (LOSS)	(DB)	1.0
TOTAL LOSSES	(DB)	156.7
TOTAL GAINS	(DB)	99.6
NET PATH LOSS	(DB)	57.1
TRANSMITTER OUTPUT POWER	(DBM)	28.5
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	-28.6
RECEIVER THRESHOLD	(DBM)	-79.0
THERMAL FADE MARGIN	(DB)	50.4

UNAVAILABILITY ONE-WAY		.000001041
UNAVAILABILITY ONE-WAY	SECONDS	32.8
RELIABILITY NON DIVERSITY		99.999896

PATH 2 WAY UNAVABILITY		.000002083
PATH 2 WAY UNAVABILITY	SECONDS	65.686
PATH 2-WAY RELIABILITY		99.999792

LONG HAUL OBJECTIVE 2-WAY	SECONDS	19.900

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RAINFALL OUTAGE CALCULATION

TRANSMIT SITE	:	WETA	
RECEIVE SITE	:	INDEPENDENT	
RAIN OUTAGE METHOD	:	U.S.	
1st & 2nd RAIN RATES- MM/YR	:	173	41
1st & 2nd RAIN TIMES- MIN/YR	:	1	100
FREQUENCY BAND-GHZ	:	11.2	
PATH DISTANCE -MI	:	25.3	
FADE MARGIN IN DB	:	50.4	
WET RADOME LOSS-DB	:	2	
POLARIZATION	:	HORIZONTAL	
ANNUAL RAIN OUTAGE-MINUTES/YEAR	:	62.7	
POLARIZATION	:	VERTICAL	
ANNUAL RAIN OUTAGE-MINUTES/YEAR	:	39.6	

NOTE: CALCULATIONS OF THE RAIN OUTAGES PER YEAR ARE BASED ON EXTRAPOLATIONS OF LONG TERM RAINFALL STATISTICS. ACTUAL RAIN OUTAGES ARE TYPICALLY SEVERAL MINUTES IN DURATION BUT MAY OCCUR ONLY ONCE OVER A PERIOD OF SEVERAL YEARS

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IV. SUPPORT DOCUMENTATION

2. Arlington (WETA) - Rosslyn

a. Path Data Sheets

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COMSEARCH, INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081
(214) 235-3156

01/07/86

	SITE A		SITE B	
SITE NAME	ROSSLYN VA		ARLING (WETA) VA	
CALL SIGN				
LATITUDE (DDMMSS.S)	38 53 41.0		38 53 29.0	
LONGITUDE (DDDMMSS.S)	77 4 19.0		77 7 55.0	
GND ELEV (FT AMSL)	100		365	
PRIMARY ANT (FCC CODE)	AD1016		AD1016	
HEIGHT (FT)	130		300	
LINE LOSS (DB)				
TYPE	ANDREW CORPORATION HP6-220		ANDREW CORPORATION HP6-220	
GAIN	49.7		49.7	
RADIO TYPE (FCC CODE)	2YFM01 M/A COM VIDEO SYSTEMS INC BV88U4MA23CC		2YFM01 M/A COM VIDEO SYSTEMS INC BV88U4MA23CC	
POWER(DBM)	18.0		18.0	
STABILITY (%)	0.030000		0.030000	
LOADING	VIDEO		VIDEO	
EMISSION DESIGNATOR	25000F9		25000F9	
FREQUENCIES	22875.00H 22825.00V 22725.00V 22625.00V 22525.00V	21675.00H 21425.00V	21625.00V 21525.00V 21325.00V	
DISTANCE	3.24 MI		5.22 KM	
BEARING (DEGREES)	265.953		85.915	

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COMSEARCH, INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081
(214) 235-3156

01/07/86

	SITE A	SITE B
SITE NAME	ROSSLYN VA	ARLING (WETA) VA
CALL SIGN		
LATITUDE (DDMMSS.S)	38 53 41.0	38 53 29.0
LONGITUDE (DDDMMSS.S)	77 4 19.0	77 7 55.0
GND ELEV (FT AMSL)	100	365
PRIMARY ANT (FCC CODE)	AD1016	AD1016
HEIGHT (FT)	130	300
LINE LOSS (DB)		
TYPE	ANDREW CORPORATION HP6-220	ANDREW CORPORATION HP6-220
GAIN	49.7	49.7
RADIO TYPE (FCC CODE)	2YFM01 M/A COM VIDEO SYSTEMS INC BV88U4MA23CC	2YFM01 M/A COM VIDEO SYSTEMS INC BV88U4MA23CC
POWER(DBM)	18.0	18.0
STABILITY (%)	0.030000	0.030000
LOADING	VIDEO	VIDEO
EMISSION DESIGNATOR	25000F9	25000F9
FREQUENCIES	23225.00V 23275.00H 23325.00V 23375.00H 23425.00V 23475.00H 23525.00V 23575.00H	22025.00V 22075.00H 22125.00V 22175.00H 22225.00V 22275.00H 22325.00V 22375.00H
DISTANCE	3.24 MI	5.22 KM
BEARING (DEGREES)	265.953	85.915

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COMSEARCH, INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081
(214) 235-3156

01/06/86

	SITE A	SITE B
SITE NAME	ROSSLYN VA	ARLING (WETA) VA
CALL SIGN		
LATITUDE (DDMMSS.S)	38 53 41.0	38 53 29.0
LONGITUDE (DDDMMSS.S)	77 4 19.0	77 7 55.0
GND ELEV (FT AMSL)	100	365
PRIMARY ANT (FCC CODE)	A63516	A63516
HEIGHT (FT)	130	300
LINE LOSS (DB)	2	2
TYPE	ANDREW CORPORATION UHX6-59H RF	ANDREW CORPORATION UHX6-59H RF
GAIN	38.8	38.8
RADIO TYPE (FCC CODE)	24LK01 MICROWAVE ASSOCIATES MA6ST07H	24LK01 MICROWAVE ASSOCIATES MA6ST07H
POWER(DBM)	30.0	30.0
STABILITY (%)	0.005000	0.005000
LOADING	VIDEO	VIDEO
EMISSION DESIGNATOR	30000F9	30000F9
FREQUENCIES	5945.20V 5974.85H 6004.50V 6197.24V 6226.89H 6256.54V	
	6034.15H 6063.80V 6093.45H 6286.19H 6315.84V 6345.49H	
	6123.10V 6152.75H 6375.14V 6404.79H	
DISTANCE	3.24 MI	5.22 KM
BEARING (DEGREES)	265.953	85.913

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IV. SUPPORT DOCUMENTATION

2. Arlington (WETA) - Rosslyn

b. Path Reliability Predictions

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COMSEARCH INC.
1307 GLENVILLE DRIVE
RICHARDSON, TX 75081

CUSTOMER: OVERSEAS TELCOM PATH NO: 1
SYSTEM:VIRGINIA
TYPE RADIO: MA2YFM01 TYPE CARRIER: VIDEO
RF FREQUENCY (GHZ): 23.275
RECEIVER IF BANDWIDTH (MHZ): 30.
CHANNEL LOADING: 1
CALCULATED CHANNEL SLOT (KHZ): 4000 SITE A: ROSSLYN
CHAN DEV (KHZ): 4000 PRE EMPHASIS CCIR SITE B: WETA
ENGINEER: L THELANER DATE:6 JAN 86

		SITE A:	SITE B
TOWER HEIGHT	(FT)	130	300
MAIN ANTENNA HEIGHT	(FT)	130	300
DIVERSITY ANTENNA HEIGHT	(FT)	0	0
MAIN ANTENNA SIZE	(FT)	6	6
DIVERSITY ANTENNA SIZE	(FT)	0	0
MAIN ANTENNA GAIN	(DB)	49.7	49.7
DIVERSITY ANTENNA GAIN	(DB)	.0	.0
MAIN WAVEGUIDE LENGTH	(FT)	2	2
WAVEGUIDE LOSS (EW220) 8.7 DB/100 (FT)	(DB)	.2	.2
STACKING LOSS	(DB)	1.0	1.0
RADOME LOSS	(DB)	.0	.0
OTHER LOSSES	(DB)	.0	
PATH LENGTH	(MI)	3.2	
SPACE LOSS	(DB)	134.0	
FIELD MARGIN (LOSS)	(DB)	1.0	
TOTAL LOSSES	(DB)	137.4	
TOTAL GAINS	(DB)	99.4	
NET PATH LOSS	(DB)	38.0	
TRANSMITTER OUTPUT POWER	(DBM)	18.0	
MEDIAN RECEIVED CARRIER LEVEL	(DBM)	-20.0	
RECEIVER THRESHOLD 10-3 BER	(DBM)	-76.0	
THERMAL FADE MARGIN	(DB)	56.0	
UNAVAILABILITY ONE-WAY		.000000001	
UNAVAILABILITY ONE-WAY	SECONDS	.0	
RELIABILITY NON DIVERSITY		100.000000	
PATH 2 WAY UNAVABILITY		.000000002	
PATH 2 WAY UNAVABILITY	SECONDS	.075	
PATH 2-WAY RELIABILITY		100.000000	
LONG HAUL OBJECTIVE 2-WAY	SECONDS	2.500	

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RAINFALL OUTAGE CALCULATION

TRANSMIT SITE	:	ROSSLYN	
RECEIVE SITE	:	WETA	
RAIN OUTAGE METHOD	:	U.S.	
1st & 2nd RAIN RATES- MM/YR	:	173	41
1st & 2nd RAIN TIMES- MIN/YR	:	1	100
FREQUENCY BAND-GHZ	:	23.275	
PATH DISTANCE -MI	:	3.2	
FADE MARGIN IN DB	:	56	
WET RADOME LOSS-DB	:	4	
POLARIZATION	:	HORIZONTAL	
ANNUAL RAIN OUTAGE-MINUTES/YEAR	:	18.4	
POLARIZATION	:	VERTICAL	
ANNUAL RAIN OUTAGE-MINUTES/YEAR	:	10.7	

NOTE: CALCULATIONS OF THE RAIN OUTAGES PER YEAR ARE BASED ON EXTRAPOLATIONS OF LONG TERM RAINFALL STATISTICS. ACTUAL RAIN OUTAGES ARE TYPICALLY SEVERAL MINUTES IN DURATION BUT MAY OCCUR ONLY ONCE OVER A PERIOD OF SEVERAL YEARS

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